GSFC 429-99-01-01

NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM (NPOESS) PREPARATORY PROJECT (NPP)

MISSION FORMULATION PLAN

September 26, 2000

"This Formulation Plan reflects the state of the program as of Mission System Requirements Review in March 2000. Review the NPP web site (www.jointmission.nasa.gov) for current and updated documents."

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

INTEGRATED PROGRAM OFFICE
SILVER SPRING, MARYLAND

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MISSION FORMULATION PLAN

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1.0 INTRODUCTION

1.1 PURPOSE

This Project Formulation Plan (PFP) represents the agreement between the NASA Earth Observing System (EOS) Program Office and the Integrated Program Office (IPO) for the work to be performed in support of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) Formulation. It defines the requirements and constraints imposed by the EOS Program Office and IPO and the services and products to be provided by the NASA NPP Project Manager and the IPO NPP Project Manager.

1.2 SCOPE

The scope of this document includes the identification of the deliverables and the formulation activities defined in 700-PG-7120.2.2A, Project Formulation, with specific emphasis on programmatic planning, concept development/refinement, system analyses, trade studies, and critical technology development.

NASA EOS funding for the formulation phase of the NPP was initiated under Unique Project Number (UPN) 288-11 EOS Follow-On. Beginning in FY 2001, UPN 803 was established for subsequent NPP funding. IPO funding for the formulation phase of the NPP is provided by IPO from the Department of Commerce (DOC) and the Department of Defense (DOD).

1.3 APPLICABLE DOCUMENTS

The following documents, or latest revisions thereto, are applicable for the formulation and execution of this PFP.

NASA Documents
- NASA Strategic Management Handbook; October 1996
- NPD 7120.4B, NASA Program/Project Management; December 1999

GSFC Documents
- GPG 1310.1, Customer Commitments and Review
- GPG 1440.7, Control of Quality Records
- GPG 7120.2, Project Management
- 700-PG-7120.2.2A, Project Formulation, August 6, 1999
- GPG 8700.1, Design Planning and Interface Management
- GPG 8700.2, Design Development
- GPG 8700.4, Technical Review Program.

IPO Documents
- Single Acquisition Management Plan (SAMP)
- Integrated Operational Requirements Document (IORD) - I
- Acquisition Strategy Report
- Test and Evaluation Master Plan (TEMP)
- Technical Requirements Document (TRD)

1.4 REFERENCE DOCUMENTS

- Advanced Technology Microwave Sounder (ATMS) Project Implementation Plan, (future)
- NPP Initial Implementation Agreement (IIA)
- Advanced Technology Microwave Sounder (ATMS) Initial Implementation Agreement (IIA)
- ATMS Final Implementation Agreement

2.0 NPP MISSION

2.1 BACKGROUND

The NPP is a joint-agency mission intending to serve the NASA and the IPO user communities. The IPO is comprised of the Department of Defense (DoD), Department of Commerce (DOC) and NASA under the authority of the tri-agency NPOESS senior executive board, the Executive Committee (EXCOM). The decision to pursue a joint mission was a direct result of discussions between IPO and NASA, and of the NASA Earth Science Enterprise (ESE) Post-2002 Mission Planning Workshop held in August 1998 in Easton, Maryland. In September 1998 the NPP was identified by IPO and NASA for feasibility study by Goddard Space Flight Center (GSFC) and the IPO. Having completed the feasibility study, and with EXCOM approval, GSFC, jointly with the IPO, is now performing the formulation phase for NPP. The joint nature of this formulation presents unique and challenging opportunities. The planning and definition are handled in an integrated manner, although the funding comes from the NPOESS and EOS Programs separately.

2.2 MISSION OBJECTIVES

The NPP provides the Earth science user community with data continuity for systematic measurements in the disciplines of terrestrial and oceanic productivity, and atmospheric temperature and humidity profiles. The NPP also provides the IPO and its users a risk reduction demonstration of capabilities for critical NPOESS instruments, their associated algorithms, and NPOESS command, control, communications, and interface data processing systems, prior to the NPOESS first launch (C1), thereby allowing lessons learned from NPP to be incorporated into NPOESS.

2.3 PROGRAM RELATIONSHIP AND RESPONSIBILITIES

As a joint agency funded mission, the Associate Director of Flight Projects for EOS and the System Program Director of IPO are responsible for Program Management and funding of their respective elements of NPP.

The NPP Initial Implementation Agreement (IIA) (see Appendix B) documents the responsibilities of NASA and IPO.

2.3.1 EOS

The Earth Observing System (EOS) is a NASA Program formed to advance the understanding of the Earth system on a global scale. The EOS Program mission objectives are:

- To create an integrated scientific observing system emphasizing climate change that will enable multidisciplinary study of the Earth's critical, life-enabling, interrelated processes involving the atmosphere, oceans, land surface, polar regions, and solid Earth, and the dynamic and energetic interactions among them

- To develop a comprehensive data and information system, including a data retrieval and processing system, to serve the needs of scientists performing an integrated multidisciplinary study of planet Earth and to make EOS data and information publicly available

- To acquire and assemble a global database for remote sensing measurements from space over a decade or more to enable definitive and conclusive studies of Earth system attributes

EOS Program Offices are located at several field centers. The Goddard EOS Program Office is designated as the EOS. The NPP Formulation Office is an organizational element of the EOS Office and receives administrative, technical and resource support from the Systems, Technology, and Advanced Concepts (STAAC) Directorate and the Applied Engineer and Technology Directorate (AETD). The Project Formulation Manager administratively reports to the Associate Director of Flight Projects for EOS. The EOS Office ensures the necessary resource support is obtained and provides guidance with regard to the general EOS program requirements. The NASA GSFC Flight Programs and Projects Directorate (Code 400) and EOS (Code 420) organization charts are referenced in Appendix C.

2.3.2 NPOESS

On May 5, 1994, the President directed convergence of the Department of Commerce/National Oceanic and Atmospheric Administration's Polar Operational Environmental Satellite (POES) program and the Department of Defense's Defense Meteorological Satellite Program (DMSP). These two programs will become the National Polar-orbiting Operational Environmental Satellite System (NPOESS). The National Aeronautics and Space Administration, through its Earth Observing System, offers new remote sensing and spacecraft technologies that could potentially improve the capabilities of the operational system. The President also directed the three agencies to establish an Integrated Program Office to manage this converged system. The Integrated Program Office provides for the planning, development, management, acquisition, and operation of a single national polar-orbiting operational environmental satellite system to satisfy both civil and national security requirements for remotely sensed meteorological, oceanographic, climatic and space environmental data. It is a tri-agency office reporting through the National Oceanic and Atmospheric Administration to an Executive Committee comprised of Under Secretary/Administrator level officials of the Departments of Commerce, Defense and the National Aeronautics and Space Administration. The NPOESS organization information is referenced in Appendix C.

2.3.3 NOAA/NESDIS

The NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) is the facility/system anticipated to provide long-term archive and distribution services for NPP as well as NPOESS. While the NPOESS requirements do not directly cover the long-term archive and distribution functions, this service must be included in overall formulation planning. NOAA representatives are integral to the NPP mission formulation. The NESDIS organization information is referenced in Appendix C.

2.4 PROJECT RELATIONSHIP AND RESPONSIBILITIES

The GSFC portion of the integrated NPP formulation team is a matrixed group with representatives from the Earth Sciences, STAAC, Flight Projects, and AETD. The IPO portion of the integrated NPP formulation team includes representatives from the IPO Acquisition, Operations and Technology Transition Directorates.

The integrated team will perform the defined formulation activities and generate the products as a unified effort. Science and operational user community representation is key to the success of the project formulation. NPP technical and programmatic aspects are presented in discussions, with regard to the user's needs and desires, to the NPOESS Operational Algorithm Teams (OATs) and the NASA Interim Science Panel (NASA ISP). The mission scientist works closely with science representatives from GSFC, NASA Headquarters, and the IPO to establish and review mission science status.

The NASA ISP represents the NASA Earth science research community during the formulation activity. The NASA ISP serves in an advisory capacity to articulate the specific requirements for NPP data in global change research and other scientific investigations. The NASA ISP reviews mission goals and objectives, operating plans, and satellite and sensor designs and specifications in light of data requirements for global change research. The NASA ISP advises the Project and Program Offices by: (1) identifying critical system capabilities; (2) ranking optional capabilities; (3) specifying preferences among competing requirements and capabilities; (4) recommending calibration procedures; and (5) recommending data processing methods and algorithms.

3.0 PROGRAM GUIDELINES AND ASSUMPTIONS

3.1 MISSION CONSIDERATIONS

The objectives of the mission are to:

- Demonstrate and validate global imaging and sounding instruments, algorithms and pre-operational ground systems prior to the first NPOESS flight.

- Provide continuity of the calibrated, validated and geo-located EOS Terra and Aqua (PM-1) systematic global imaging and sounding observation for NASA Earth Science research.

NPP Program Management defines the Formulation Program Requirements and provides those to the NPP Formulation Team. All NPP lower level requirements will be derived from the Program Requirements The Program Requirements are given in Appendix D. To meet all objectives as a bridge between the EOS Terra and Aqua and the NPOESS-C1 and as risk reduction for NPOESS, NPP is planned for a FY06 launch with a mission design life of 5 years. The instruments to be accommodated on NPP include the Visible Infrared Imaging Radiometer Suite (VIIRS), and an atmospheric sounder suite comprised of Cross-track Infrared Sounder (CrIS) and the Advanced Technology Microwave Sounder (ATMS).

The NPP Initial Implementation Agreement (IIA), see Appendix A, identifies the planned work division between NASA and IPO. While no exchange of funds between agencies is planned, an equitable cost split is contained in the IIA. Refinement of the mission operations concept and the associated implementation approach may result in recommended changes to those current working assumptions. NASA and IPO are individually responsible for the management and oversight of the identified mission element acquisitions. The formulation team will collectively evaluate the mission requirements, operations concepts, and design alternatives suitable to best satisfy the Program requirements.

3.2 ENABLING TECHNOLOGIES

Enabling technologies are those technologies that are required to meet mission objectives.

3.2.1 Low Noise Amplifier (LNA)

LNA technology provides the ATMS instrument with a design that is smaller and lighter and consumes less power compared to heritage instruments (AMSU A1/A2, and MHS). The use of the LNA technology provides for an overall reduction in the instrument resource requirements placed on the spacecraft allowing for a reduction in mission costs.

3.2.2 Ground Station Interface Facility (GSIF)

The GSIF is a NASA-developed data buffering facility to buffer high-rate data from ground-station receivers and the network services back to the continental United States. (CONUS). The GSIF can support multiple missions. The GSIF is part of the NPP Command, Communication, and Control Segment (C3S).

3.3 ENHANCING TECHNOLOGIES

There are at least four technologies being assessed as potential technology demonstrations that could significantly improve the data handling and provide the capability to provide products directly to the user. This translates into some redundant and additional functionality and some increase to the development costs. But, the benefit of including these demonstrations would be reduced mission operations and communication costs in the future.

3.3.1 Optical Communication

Optical communication technology provides the ability to cross-link science data between the NPP and commercial or other communication satellites which subsequently down-link the data to a ground receive/gateway site or uplink to a GEO relay. This technology offers the possibility of higher bandwidth, reduced dedicated ground receive stations, dedicated communication and data routing circuits, and more timely data receipt at the user processing sites.

3.3.2 On-board Processing

The capability of providing on-board processing of science data and directly down-linking the resulting data products offers a potentially highly useful and cost effective means of providing information products directly to the users. While the raw data would still be down-linked, this demonstration extends ground based processing, even at a minimal first level data product, to the spacecraft, allowing more timely availability of data products to the user. The ability to perform space-based processing is highly dependent on Random Access Memory (RAM) based Field Programmable Gate Array (FPGA) technology, which is currently in development as a ground processing technology for use in NPP.

3.3.3 Advanced Data Bus Architecture

Advanced spacecraft data bus architectures and components will be investigated owing to the high output data rate of the instruments (approximately two orders of magnitude greater than DMSP and POES instruments, and of the approximately the same order of magnitude as EOS Terra and EOS Aqua instruments). This translates to high data rate handling, storage, and down-link from the spacecraft. Consequently, different interfaces, data buses, and data storage approaches will be investigated.

3.3.4 Ka-band Phased Array

The Ka-band phased array is currently in development under a GSFC contract. Completion of this activity and the development of a protoflight unit would allow the Ka-band phased array to be flown on NPP as a technology demonstration. This will support IPO evaluation of Ka-band for downlink.

4.0 FORMULATION PHASE ACTIVITIES AND DELIVERABLES

4.1 FORMULATION PHASE ACTIVITIES

The goal of the NPP formulation phase is to define the mission with sufficient detail in the technical, management, budget and institutional plans to enable a firm commitment to management for the implementation phase.

The formulation phase is planned to run from May 99 through December 01. The schedules for the NPP mission and formulation are given in Appendix E. A Mission Systems Design Review (MSDR) is scheduled for March 01.

Expenditures for the GSFC formulation phase activities are organized by Job Order Numbers (JONs). Documentation to be provided during NPP formulation is outlined in the NPP Formulation Documentation Tree shown in Appendix F.

4.2 FORMULATION DELIVERABLES/SERVICES

The deliverables and services to be performed during the formulation phase and the targeted delivery date are listed below.

Deliverable/Service	Target Delivery Date
Formulation Management	
- Formulation Schedule	April 00
- Project Implementation Plan (Draft, Baseline)	July 00/April 01
- Project Cost Commitment	December 01
- Master Implementation Schedule	December 01
Science Management	
- Calibration/Validation Plan (Draft/Baseline)	March 00/April 01
- Science Plan (Draft/Baseline)	March 00/April 01
Mission/System	
- System & Operations Concept Baseline	April 00
- Performance Verification Plan (Draft/Baseline)	July 00/April 01
- Technology Plan (Draft/Baseline)	March 00/April 01
- Transition Plan (Draft/Baseline)	March 00/April 01
- Mission Requirements Review	March 00
- Level 2 Requirements Baseline	April 00
- Architecture Description Document	April 01
- Quality Assurance Plan	April 01
- Safety & Security Plan	April 01
- System Integration & Test Plan	April 01
- Business Opportunity Plan	April 01
- Mission Design/Confirmation Review	December 01
- Level 3 Requirements Baseline	April 01
Space Segment	
- Instrument/Spacecraft Accommodation Studies	Sept. 00/Sept. 01

- S/C Approach Decision	November 00
- CrIS downselect	August 99
- VIIRS downselect	October 00
- ATMS Formulation Award	November 99
- ATMS Implementation Award	February 01
Ground Segments	
- Program Definition & Risk Reduction (PDRR) Award	December 99
- NPOESS System Engineering and Manufacturing Development (EMD)	March 02
Technology Development	
- Proto Flight Ka-band Phased Array	August 02

4.3 RISK ASSESSMENT

Successful completion of the NPP formulation phase, within program constraints, is contingent on completion of several activities outside the scope of this plan. The risk associated with each activity is given in the following sections.

4.3.1 Instrument Resource Growth

Feasibility study analysis used instrument resource requirements known at the time. Should these requirements increase, a larger or more capable spacecraft and launch vehicle may be required.

4.3.2 Coordination of Mission Segments

Strong coordination of all mission segments, in particular coordination between segments provided by different agencies (Space Segment-to-Command, Communication, and Control Segment (C3S); Interface Data Processor Segment (IDPS)-to-Science Data Segment (SDS), SDS-to-Archive and Distribution Segment [ADS]) is essential to the integrated development of NPP.

5.0 REPORTING

Due to joint agency relationship, close coordination and interaction is essential, with regularly scheduled status meetings and technical working group sessions. Additionally, periodic Program Management (Associate Director of Flight Projects for EOS and IPO System Program Director) meetings are expected. Continued participation at the regularly scheduled GSFC Directorate status meetings are also planned. In support of the monthly GSFC and IPO status meetings a single, integrated, joint monthly presentation package will be developed and coordinated by the NASA NPP Project Manager and the IPO NPP Project Manager.

A Joint Formulation Team Weekly Status Meeting will be convened at which point all mission segment leads, the mission systems lead, schedule lead, resources lead, will present status of all elements of the mission.

A monthly NPP Report will be prepared and presented to EOS and IPO senior management.

Starting in CY 00, monthly status reports will be prepared by NASA and IPO segment leads and presented to the NASA NPP Project Manager and the IPO NPP Project Manager.

Informal verbal and electronic communications are expected to be a common and frequently utilized form of information exchange especially in light of the distributed team locations and assigned work splits.

Appendix A

ACRONYMS AND ABBREVIATIONS

ADS	Archive and Distribution Segment
AETD	Applied Engineering and Technology Directorate
AMSU	Advanced Microwave Sounding Unit
ATMS	Advanced Technology Microwave Sounder
C1	Charlie One
C3S	Command, Communication, and Control Segment
CADU	Channel Access Data Unit
CDA	Command and Data Acquisition
C&DH	Command and Data Handling
CDRL	Contract Data Requirements List
CONUS	Continental United States
CrIS	Cross-track Infrared Sounder
DMSP	Defense Meteorological Support Program
DOC	Department of Commerce
DOD	Department of Defense
EDR	Environmental Data Record
ELV	Expendable Launch Vehicle
EM	Engineering Model
EOS	Earth Observing System
ESE	Earth Science Enterprise
EUMETSAT	European Organization for the Exploration of Meteorological Satellites
EXCOM	Executive Committee (NPOESS)
FIA	Final Implementation Agreement
FPGA	Field Programmable Gate Array
FY	Fiscal Year
GFE	Government Furnished Equipment
GFP	Government Furnished Property
GPG	Goddard Procedures Guidelines
GSFC	Goddard Space Flight Center
GSIF	Ground Station Interface Facility
IASI	Infrared Atmospheric Sounding Interferometer
ICD	Interface Control Document
IDPS	Interface Data Processor Segment
IIA	Initial Implementation Agreement
IORD	Integrated Operational Requirements Document
IPO	Integrated Program Office
IRD	Interface Requirements Document

ACRONYMS AND ABBREVIATIONS (Continued)

ISP	Interim Science Panel
JON	Job Order Number
LNA	Low Noise Amplifier
LV	Launch Vehicle
MCR	Mission Confirmation Review
MDR	Mission Design Review
MELV	Medium Expendable Launch Vehicle
MHS	Microwave Humidity Sounder
MOA	Memorandum of Authorization
MODIS	Moderate-Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MRR	Mission Requirements Review
MSDR	Mission System Design Review
NASA	National Aeronautics and Space Administration
NESDIS	NOAA Environmental Data and Information System
NLT	Not Less Than
NPD	NASA Program Directive
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
OAT	Operational Algorithm Team
PCA	Program Commitment Agreement
PFM	Proto-Flight Model
PFP	Project Formulation Plan
PG	Procedures and Guidelines
POES	Polar Operational Environmental Satellite
RAM	Random Access Memory
RDR	Raw Data Record
RFI	Request for Information
RFP	Request for Proposal
RFO	Request for Offer
RSDO	Rapid Spacecraft Development Office
SAMP	Single Acquisition Management Plan
SDR	Sensor Data Record
SDS	Science Data Segment
SEB	Source Evaluation Board
SRD	Sensor Requirements Document
STAAC	System Technology and Advanced Concepts
TBD	To Be Determined

ACRONYMS AND ABBREVIATIONS (Continued)

TBR	To Be Resolved
TBS	To Be Supplied
TDRSS	Tracking Data Relay Satellite System
TSPR	Total System Performance Responsibility
UPN	Unique Project Number
VIIRS	Visible Infrared Imaging Radiometer Suite
WBS	Work Breakdown Structure

Appendix B

INITIAL IMPLEMENTATION AGREEMENT

BETWEEN

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OFFICE OF EARTH SCIENCE

AND

THE NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL

SATELLITE SYSTEM INTEGRATED PROGRAM OFFICE

FOR THE

NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM PREPARTORY PROJECT

I. PURPOSE.

The Office of Earth Science of the National Aeronautics and Space Administration (NASA) and the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Integrated Program Office (IPO) hereby agree to enter into a partnership to jointly formulate a mission called the NPOESS Preparatory Project (NPP) to accomplish the following objectives:

1. Demonstrate and validate global imaging and sounding instruments, algorithms and pre-operational ground systems prior to the first NPOESS flight.

2. Provide continuity of the calibrated, validated and geo-located EOS Terra and PM-1 systematic global imaging and sounding observations for NASA Earth Science research.

As a minimum, NPP should provide atmospheric sounding and earth surface imaging measurements which meet the Earth Science Enterprise science needs and the IPO NPOESS requirements. It should launch in late-2005 with a mean mission duration in orbit of at least 5 years. The instruments flown on this mission will also be flown and operated on the NPOESS and/or METOP spacecraft flown by the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT).

This Initial Implementation Agreement (IIA) identifies the respective partners' responsibilities to be used for the formulation phase of the mission. This is in accord with the policy and procedures set forth in Appendix 1 of the Memorandum of Agreement Between the Department of Commerce, Department of Defense, National Aeronautics and Space Administration For The National Polar-orbiting Operational Environmental Satellite System, dated May 26, 1995.

II. RESPONSIBILITIES

The IPO and the NASA Office of Earth Science shall jointly manage the program and assume the following division of responsibilities:

IPO:

1. Manage and fund the development and procurement of the Cross-Track Infrared Sounder (CrIS) and associated NPOESS related algorithms consistent with the terms and conditions in the IIA between NASA and IPO for an Advanced Technology Microwave Sounder signed August 27, 1998.

2. Manage and fund the development and procurement of the Visible - Infrared Imager Radiometer Suite (VIIRS) and associated NPOESS related algorithms to meet agreed upon NPOESS/NASA requirements.

3. Provide mission flight operation following the formal hand-over by NASA at the conclusion of the post-launch on-orbit checkout.

4. Provide the following ground system capabilities:
   - Stored mission data receive ground stations
   - Primary and backup telemetry and command via National Oceanic and Atmospheric Administration (NOAA) Command and Data Acquisition (CDA) facilities, Air Force Satellite Control Network
   - Network services for data return to Continental United States (CONUS)
   - Prototype operational data processing
   - Prototype operational calibration and validation
   - Ground system integration

NASA:

1. Perform mission systems engineering, integration and testing.

2. Manage and fund the development and procurement of the spacecraft bus.

3. Manage and fund the development and procurement of the Advanced Technology Microwave Sounder (ATMS), consistent with the terms and conditions in the IIA between NASA and IPO for an Advanced Technology Microwave Sounder signed August 27, 1998.

4. Manage and fund the procurement of the launch vehicle.

5. Prepare for, conduct, and oversee launch and post-launch on-orbit checkout.

6. Provide the following ground system capabilities:
   - Rate buffer subsystem for ground stations
   - Backup telemetry and command via Tracking and Data Relay Satellite (TDRSS)
   - Make available to the IPO and/or NOAA any science processing/re-processing capability developed by NASA for NPP.

7. Provide engineering support for anomaly resolution for the life of the mission.

NASA and NPOESS IPO will jointly assume system program management responsibilities and develop integrated performance milestones to be achieved for the formulation, implementation, and operation of the mission and a transition plan to migrate the instruments to future operational NPOESS platforms. Changes involving schedules, costs, or system performance will be promptly communicated as necessary between NASA and IPO.

NASA and NPOESS IPO will jointly participate with NOAA in science level calibration/validation activities for NPP.

Responsibility for data archiving and distribution of data acquired from the NPP spacecraft will be negotiated between NASA and IPO, and/or their respective sponsoring organizations.

Community specific data handling will be the responsibility of the respective organizations.

Periodic mission status reports will be provided to NASA and IPO management.

Each party shall share cost, schedule, and mission justification information with the other in the appropriation process and shall reconsider this agreement should conditions merit.

III. FUNDING.

There shall be no exchange of funds between NASA and IPO. All activities pursuant to this IIA are subject to the availability of appropriated funds, and no provision herein shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C. § 1341. This IIA is not a funding document, and does not represent the obligation or transfer of funds.

IV. EFFECTIVE DATE

This IIA shall be effective upon the date of the last signature below. It is the intention of the parties to enter into a Final Implementation Agreement at the end of mission formulation and prior to the beginning of implementation (Phase C/D) activity. The formulation phase is expected to be complete in FY 2001.

Ghassem Asrar
Associate Administrator
for Earth Science

20 August 1999
Date:

Gregory Withee
Assistant Administrator
for Satellite and Information Services

26 August 1999
Date:

Richard McCormick
Deputy Assistant Secretary
for Space Plans and Policy

21 November 1999
Date

Appendix C

ORGANIZATION CHARTS

1. To view the **NASA Goddard Space Flight Center Organization Chart** go to the following website http://www.gsfc.nasa.gov/gsfc/org/org.htm for the current version.

2. To view the **NASA GSFC Code 400 Organization Chart** go to the following website http://fpd.gsfc.nasa.gov/management.html for the current version.

3. To view the **EOS Program Office Organization** go to the following website http://eos.gsfc.nasa.gov/organization.html for the current version.

4. To view the **NPOESS Integrated Program Office Organization Chart** go to the following website http://www.ipo.noaa.gov for the current version.

Appendix D

3/28/00

NPP Mission Formulation Program Requirements
(Items 1-3 are carried up to the PCA)

These baselined requirements will be refined by NASA and the IPO through the NPP system engineering process as necessary during the formulation process.

Mission

1. The NPP spacecraft shall accommodate the following instruments:
   1.1. Visible Infrared Imaging Radiometer Suite (VIIRS) provided by IPO (NLT June 30, 2004)
   1.2. Cross-track Infrared Sounder (CrIS) provided by IPO (NLT April 30, 2004)
   1.3. Advanced Technology Microwave Sounder (ATMS) provided by NASA (NLT October 1, 2004)
2. The Launch Readiness Date (LRD) for the NPP spacecraft shall be in FY06.
3. The NPP spacecraft shall be designed for launch by a MELV-class launch vehicle.
4. The NPP spacecraft shall be designed for an on-orbit life of a minimum of five years.
5. The NPP spacecraft shall be inserted into a polar sun-synchronous orbit having the following characteristics:
   5.1. Nominal altitude of 824 $\pm$ 17 km
   5.2. Ground track repeat accuracy of $\pm$ 20 km at the Equator
   5.3. Nominal descending equatorial crossing time of 10:30 AM $\pm$ 10 minutes.
6. The NPP mission shall capture at least 98% of collected mission data on an annualized basis.

Command, Control, and Communications

7. The NPP stored mission data shall be down-linked, on X-band, directly to the ground (TBR).
8. The NPP spacecraft shall be capable of directly broadcasting (on X-band) all instrument data in real time (TBR).
9. The primary telemetry and command system for the NPP mission shall be the unified S-band via NOAA Command and Data Acquisition (CDA) sites.
10. The secondary telemetry and command system for the NPP mission shall be the unified S-band via the Tracking and Data Relay Satellite System.
11. The backup telemetry and command system for the NPP mission shall be the unified S-band via selected Air Force Satellite Control Network sites and the Tracking and Data Relay Satellite System.

Mission Data

12. The NPP Environmental Data Records (EDRs) will be delivered to a weather Central within three hours of acquisition.

13. The NPP mission shall provide Climate data processing and reprocessing for the mission life plus three years.
14. The NPP mission shall provide Climate research products to science users.
15. The NPP mission shall be capable of providing RDRs, SDRs, and EDRs for use by NASA investigators.
16. The NPP mission shall conduct pre-launch calibration and post-launch validation activities, including unique calibration data processing.
17. The NPP mission shall make available RDRs, SDRs, EDRs, and Climate research products via an active archive provided and operated by NOAA (TBR).

Technology

18. The NPP mission shall include a technology demonstration of Ka-band phased array high data rate downlink.
19. The NPP mission shall provide a prototype (low-cost) X-band direct broadcast ground station for data receipt and rudimentary processing.

Requirements on IPO

20. The NPP mission shall use the system provided and operated by IPO to conduct mission operations.
21. The NPP mission shall use the system provided and operated by IPO capture the stored mission data from the NPP spacecraft.

Requirements on NASA HQ

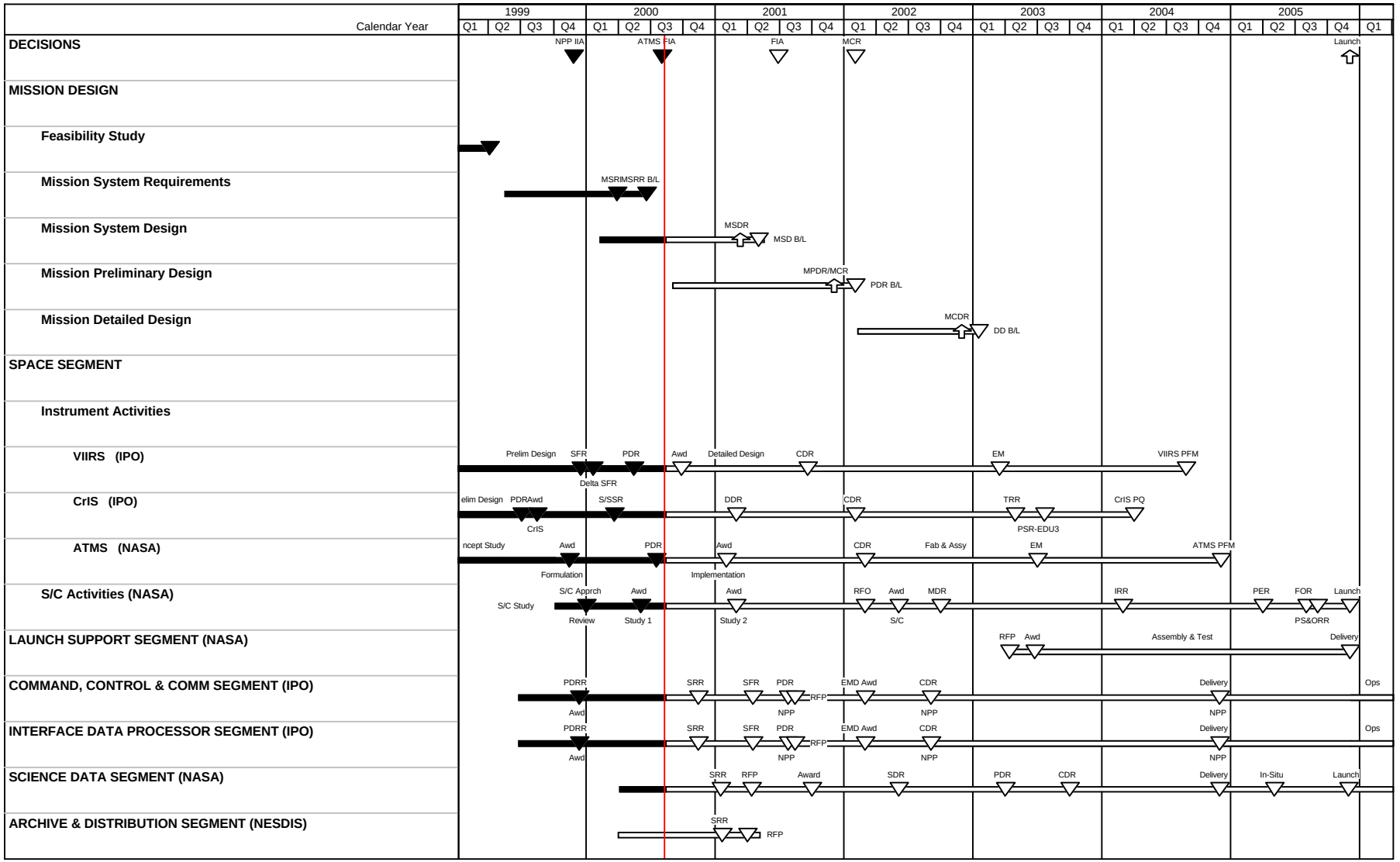
22. NASA HQ shall assign, no later than the June 1, 2001, a MELV-class ELV to the NPP mission.
23. NASA HQ shall sign the Final Implementation Agreement (FIA) with DOD and DOC/NOAA by July 1, 2001.
24. NASA HQ shall sign the Final Implementation Agreement (FIA) with DOD and DOC/NOAA by December 15, 2000.
25. NASA HQ shall sign the Memorandum of Agreement with DOC/NOAA for long term active archive by the NPP Mission Design Review (March 2001).

Appendix E

PRELIMINARY

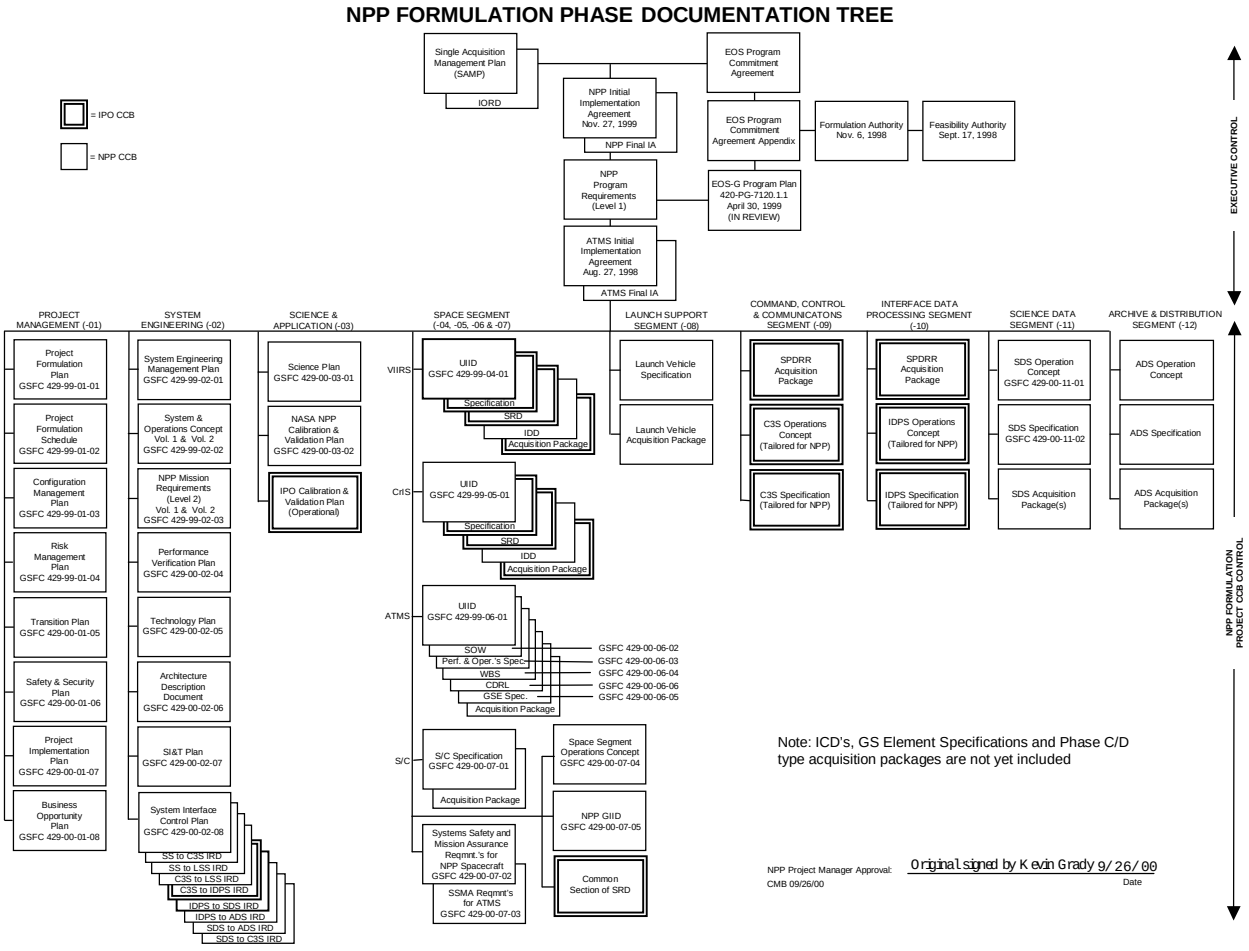
Figure E-1. NPP Mission and Formulation Schedule

Status as of 8/11/00



Appendix F

Figure F-1. NPP Formulation Document Tree



NOTE: See the NPP Configuration Management Office for the current version of the NPP Formulation Document Tree.

All jointly signed documents also require the NPOESS CCB approval.

Appendix G

FEASIBILITY AND FORMULATION REFERENCE MATERIAL

Figure G-1. Formulation Authorization Memorandum

Formulation Authorization

Bridge Mission between EOS AM-1, EOS PM-1, and NPOESS-C1
(Temporary Title)

PURPOSE

Pursuant to providing the continuous, systematic measurements needed to meet Objectives 1.1, 1.2, and 1.4 of Goal 1 of the Enterprise Strategic Plan 1997-2000 (issued May, 1997), formulate a mission to bridge the gap between the Earth Observing System (EOS) AM-1 and EOS PM-1 flights and the National Polar-Orbiting Operational Environmental Satellite System (NPOESS)-sponsored flights commencing with NPOESS-C1. This mission must both meet the Earth Science Enterprise science needs and demonstrate operational capabilities by mitigating the risks associated with new technologies being employed. As a minimum, it should include atmospheric sounding and earth surface imaging measurements. It should launch in mid-2005 with a design lifetime in orbit of 5 years. The end product of this task shall be a formal proposal submitted to my office accompanied by a Project Plan, a proposed modification to the EOS PCA, and a statement of GSFC's commitment to their role in this project.

TERMS OF REFERENCE

This task includes defining roles and responsibilities, as well as technical, budget, and schedule objectives. This task includes determining how this mission can be accomplished in the most cost-effective manner for the American taxpayer. Full cost-analyses across not only the end-to-end life-cycle of this mission, but also across various implementation approaches are expected.

FUNDING

Funding for FY99 is 900 K$. Funding for the remainder of the formulation of this mission (i.e., through proposal submission, expected late in FY00) will be determined following a status report and review late in FY99.

INTERNAL PARTICIPANTS

The GSFC is tasked to lead the development of this plan; other centers may be called upon as needed.

EXTERNAL PARTICIPANTS

The NPOESS Integrated Program Office (IPO) is identified as a partner in defining requirements and sharing the overall cost of the mission on a equitable basis. They will be consulted throughout the definition, solicitation, development, and execution phase. The IPO has expressed interest in assuming the full implementation responsibility for follow-on future mission(s) if this mission is successful. This situation requires the ability to novate the contract(s) over to the IPO in the future. The NPOESS participation is covered by the Memorandum of Agreement signed by NASA and the Departments of Commerce and Defense on May 26, 1995.

Enterprise Associate Administrator

6 Nov. 98
Date

Figure G-2. NPP Tasking Memorandum

National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001

Reply to Attn of Y

SEP 17 1998

TO: Goddard Space Flight Center
Attn: Director

FROM: Y/Associate Administrator for Earth Science

SUBJECT: Proposed Bridge Mission between EOS AM-1, EOS PM-1 and NPOESS-C1

I am tasking the Goddard Space Flight Center (GSFC) to develop a plan for a mission to bridge the gap between the Earth Observing System (EOS) AM-1 and EOS PM-1 flights and the National Polar-Orbiting Operational Environmental Satellite System (NPOESS)-sponsored flights commencing with NPOESS-C1. This gap-filler mission is intended both to meet the Earth Science Enterprise science needs and to demonstrate operational capabilities. As a minimum, it should include atmospheric sounding and earth surface imaging capabilities. It should launch in mid-2005, regardless of the current state of health of various contemporary Defense Meteorological Satellite Program (DMSP) and National Oceanic and Atmospheric Administration (NOAA) spacecraft. It should have a design lifetime in orbit of 5 years. Since substantial NPOESS Integrated Program Office (IPO) contributions are expected, this task should result in a partnership with the IPO and respond to their operational requirements, except for demonstrating 7-year longevity. The plan you develop must define roles and responsibilities, as well as technical, budget, and schedule objectives, and must specify GSFC's commitment to their role in this project. I am appointing the GSFC the responsible lead center and shall hold it accountable for mission success, pending formal authority to proceed.

The end product of the first phase of this task shall be a formal proposal submitted to my office. This phase includes determining how this mission can be accomplished in the most cost-effective manner to the American taxpayer. The formal proposal should include defining the overall mission, including acquiring appropriate instruments; specifying, integrating, launching, and operating the spacecraft; developing and installing algorithms; accommodating data and information needs; and planning and executing science verification. That is, carry out all tasks necessary to accomplish this mission from its inception through its completion. As a part of this assignment, a transition plan to migrate the instruments to future operational platforms must be produced. It should also produce a recommended equitable cost split between NASA and the NPOESS IPO, and state the rationale for that split. Thus, I expect a full cost-analysis across not only the end-to-end life-cycle of this mission, but across various implementation approaches as well.

Initial planning assumptions should include flying an atmospheric sounder (IR and microwave instrument system) and an imager. Among the instruments to be considered are an NPOESS IPO-supplied Crosstrack Infrared Sounder (CrIS), a NASA-supplied Advanced Technology Microwave Sounder (ATMS), and an imager such as an augmented Visible/Infrared Imager Radiometer Sounder (VIIRS). Our commitment to produce the ATMS, per the Initial

Figure G-2. NPP Tasking Memorandum (Continued)

Implementation Agreement signed August 27, 1998, (copy enclosed) should be addressed in your plan. I note that cost sharing may include options such as our contributing to an NPOESS-supplied instrument, and vice-versa. These assumptions should be revisited in light of the final level-1 requirements.

The role of Headquarters in this effort is to set policy, to define level-1 requirements, to provide clarification as needed, and to provide inter-agency support and liaison. Recognizing that our level-1 requirements are under review at present, a small team under Dr. Ramesh Kakar is being organized to formulate level-1 sounder requirements, and another team under Dr. Diane Wickland is being organized to formulate level-1 imager requirements.

This mission should provide continuity in systematic measurements following the EOS series-1 missions until such measurements can be reasonably assumed by NPOESS missions. Since we expect to depend upon these instruments flying on NPOESS spacecraft in the future, NPOESS operational requirements must be demonstrated on this bridge mission. This task is not a continuation of the Polar-Orbiting Operational Environmental Satellite (POES) effort, but rather has evolved out of the EOS program and should be managed as such. Therefore, I ask that a new organization carry out this new mission, as distinct from extending current Project Offices such as those for the POES and EOS AM-1 and EOS PM-1 projects.

Please report back to me, as soon as possible, with an implementing organization, lead personnel assignments, and a schedule to produce your proposal. I consider this mission to be a NASA mission, and expect NASA leadership throughout. During the definition phase, tight coordination with Headquarters is essential.

Dr. Charles Wende (202-358-0748, cwende@hq.nasa.gov) will be GSFC's initial lead contact at NASA Headquarters in this matter. After this mission receives authority to proceed, GSFC will assume implementation responsibility as the lead center. Additional Headquarters support will be made available as needed.

Ghassem R. Asrar

Enclosure

cc:
NPOESS IPO/Director